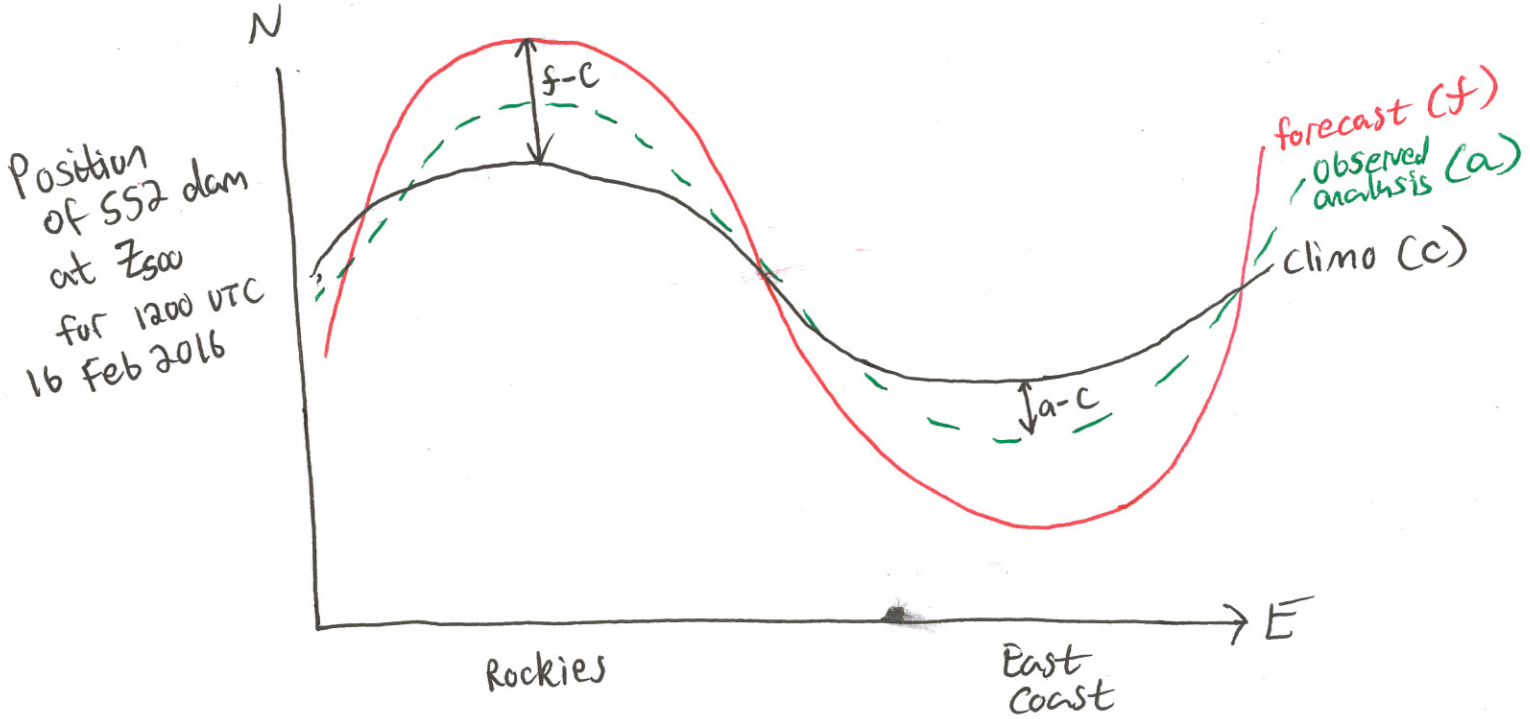
ACC Example

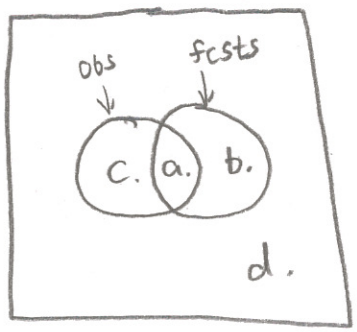


Position of 552 dam at Z500 for 1200 UTC 16 Feb 2016

Contingency Table:

- Here is an example of a simple 2x2 contingency table:

forecast \ observations	Yes	No
Yes	hits a.	false alarms b.
No	misses c.	correct reject d.



An example of a contingency table may look like this:

	obs rain	obs dry
fcst rain	18	2
fcst dry	12	68

- The "SEEPS" score (Stable Equitable Error in probability Space) is an extension of the contingency table.
- Addresses the task of verifying deterministic precipitation forecasts.
- In contrast to traditional deterministic precipitation verification, SEEPS makes use of three categories:
  (1) "dry", (2) "light precipitation", and (3) "heavy precipitation"
  - "Dry" is defined according to WMO guidelines as ≤ 0.2 mm/24h
- "Light" and "heavy" categories are defined by local climatology so that light precipitation occurs twice as often as "heavy" precipitation.
  → E.g., in Europe, the threshold between "light" and "heavy" precipitation is generally between 3 and 15 mm/24h.

Example:

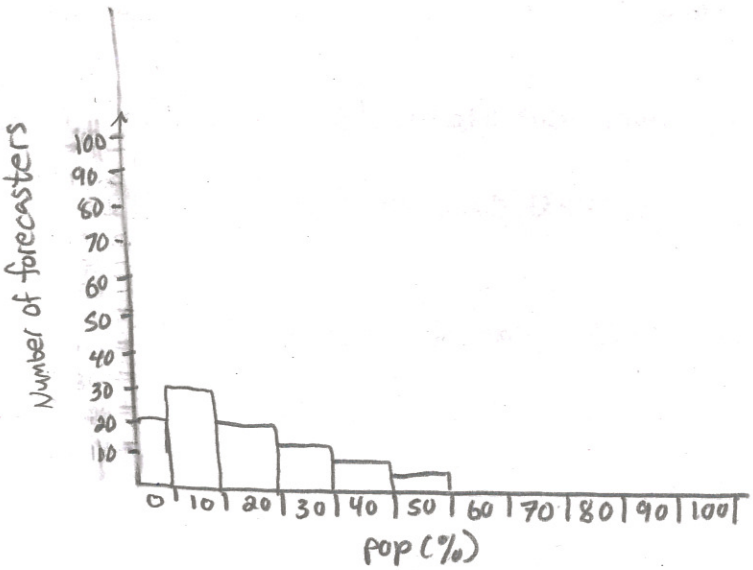
	obs Dry	obs light precip	obs heavy precip
fcst dry	10	7	5
fcst light precip	8	20	10
fcst heavy precip	2	3	35

- This and other contingency tables like Table 7 on page 97 in ECMWF user guide illustrate how contingency tables can be made to be more complex than a 2x2.

CRPSS Example

Let us pretend 100 students are forecasting probability of precipitation (pop) for 12 Feb 2016. Let's say it does not rain, so the verification is a pop of 0.

Here is the forecast distribution for pop



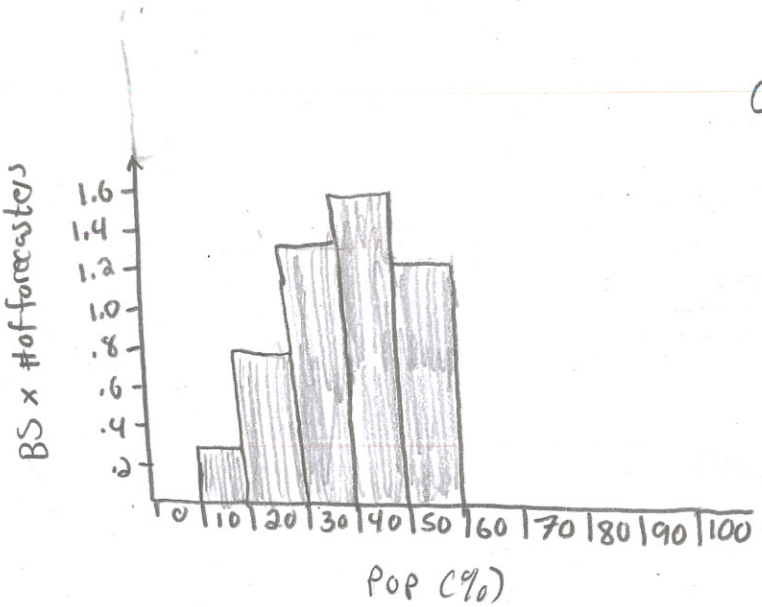
Brier Score (BS)

$BS = \overline{(p-o)^2}$

p = forecast probability

o = occurrence; either:
0 - did not happen
or 1 - did happen

Pop Cat:	0	.10	.20	.30	.40	.50	.60	.70	.80	.90	1.0
obs:	0	0	0	0	0	0	0	0	0	0	0
Brier Score:	0	.01	.04	.09	.16	.25	.36	.49	.64	.81	1.0
# of forecasters	20	30	20	15	10	5	0	0	0	0	0
BS x # of forecasters	0	0.3	0.8	1.35	1.6	1.25	0	0	0	0	0



CRPS = total area / # categories

$CRPS = \frac{5.3}{11} = 0.482$

- This example basically illustrates that the CRPS is basically the average BS across all categories of what you're interested in forecasting (e.g., pop).
- How do we get the CRPSS?

CRPSS - Continuous Rank Probability Skill Score, can be calculated as follows:

$$CRPSS = \frac{\overline{CRPS_{forecast}} - \overline{CRPS_{climo}}}{\overline{CRPS_{perfect}} - \overline{CRPS_{climo}}}$$

- This skill score measures the improvement over the standard forecast, normalized to the total possible improvement.
  - Range is $-\infty$ to 1, so max possible CRPSS (and perfect forecast) is CRPSS = 1.

Since a perfect CRPS is zero, CRPSS can be rewritten as:

$$CRPSS = \frac{\overline{CRPS_{climo}} - \overline{CRPS_{forecast}}}{\overline{CRPS_{climo}}}$$

- The CRPSS can also be thought of as an averaged Brier skill score across a continuous distribution of categories (e.g. categories of POP).

Recall that Brier score (BS) is:

$BS = \overline{(p-o)^2}$, where p is probability of occurence of event and o is its occurence (0 or 1).

The Brier Skill Score (BSS) is:

$$BSS = \frac{BS_{forecast} - BS_{climo}}{BS_{perfect} - BS_{rererence}}$$

since $BS_{perfect} = 0$

$$BSS = \frac{BS_{climo} - BS_{forecast}}{BS_{climo}}$$

In a basic sense:

$$CRPSS = \frac{\sum_{i=1}^{\#\text{ of categories}} BSS}{\#\text{ of categories}}$$